

PERFORMANCE COMPARISON BETWEEN ADAPTIVE LINE ENHANCERS AND FFT FOR FAST CARRIER ACQUISITION

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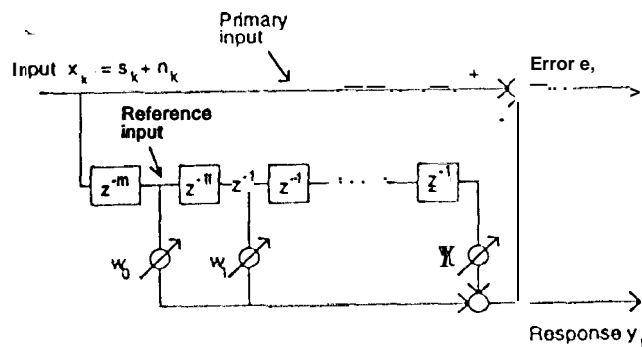
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ABSTRACT

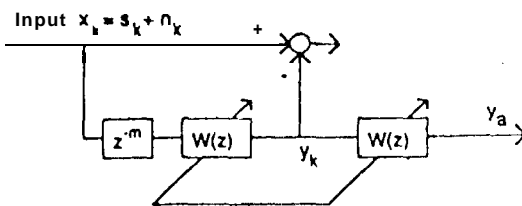
Three adaptive line enhancer (ALE) algorithms and architectures, namely conventional ALE, ALE with Double Filtering (ALEDF), and ALE with Coherent Accumulation (ALECA) are investigated for fast carrier acquisition in time-domain. The architectures of these three ALEs are shown in Figure 1. The advantages of these algorithms are their simplicity, flexibility, robustness and applicability to general situations including the earth-to-space uplink carrier acquisition and tracking of the spacecraft. In the acquisition mode, these algorithms act as bandpass filters, hence the CNR is improved for fast acquisition. In the tracking mode, these algorithms simply act as lowpass filters to improve Signal-to-Noise Ratio (SNR), hence better tracking performance is obtained. It is not necessary to have a priori knowledge of the received signal parameters, such as CNR, Doppler and carrier sweeping rate. The implementation of these algorithms is in time-domain (as opposed to frequency-domain, such as FFT). The carrier frequency estimation can be updated in real-time at each time sample (as opposed to the batch processing of FFT). The carrier frequency to be acquired can be time-varying. Performance of these ALEs are analyzed. Simulations are conducted for both fixed and swept uplink carrier frequency for the deep space transponder applications. Performance comparison study shows that the ALECA provides a narrowest spectral peak at the correct carrier frequency among all other acquisition methods including FFT technique. Specifically, during the sweeping operation, the ALECA can acquire the uplink carrier frequency precisely while the FFT technique fails due to the frequency smearing problem.

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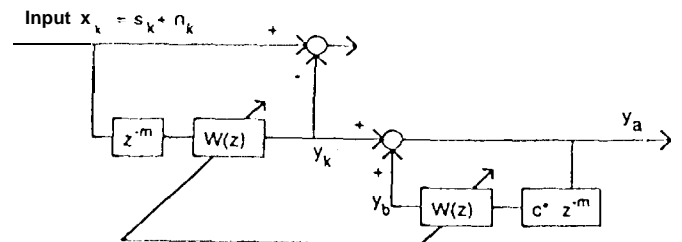
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(a)



(b)



(c)

Figure 1. Architectures of the (a) conventional ALE, (b) ALE with double filtering, (c) ALE with coherent accumulation.